

A NEW PYEMOTES (ACARI: PYEMOTIDAE) REARED FROM THE DOUGLAS-FIR CONE MOTH

J. C. Moser,¹ R. L. Smiley² and I. S. Otvos³

1. USDA Forest Service, 2500 Shreveport Highway, Pineville, LA 71360. 2. Systematic Entomology Laboratory, Agricultural Research Service, USDA, Beltsville, MD 20750. 3. Canadian Forestry Service, Pacific Forestry Centre, 506 Burnside Rd., Victoria, BC V8Z 1M5

ABSTRACT — *Pyemotes barbara*, n. sp., is illustrated and described. This species is parasitic on pupae of *Barbara colfaxiana* (Kearfott), one of the important cone and seed pests of Douglas-fir, *Pseudotsuga menziesii* (Mirbel) Franco. The *Pyemotes* mite considered here is a candidate for the biological control of forest insects.

INTRODUCTION

The 15 known species of *Pyemotes* (Cross, et al., 1981) are insect parasites exhibiting a wide variety of trophic diversity as well as dispersal polymorphisms.

The genus naturally divides into two distinct subgroups. In the *scolyti* subgroup, all five species are phoretic on one or more species of bark beetles (Scolytidae); none of these mites has venom. In nature, all feed only on bark beetle brood or on immatures of other beetles in the subcortical habitats; none feeds on adults. At least one female morph of each of the five species is a phoretomorph; and one species expresses the most extreme polymorphism known for mites. In the *ventricosus* subgroup, its 10 species are not known to be phoretic; at least two species possess venom. These 10 attack a variety of hosts, and some species, at least, even attack and feed on adult insects; no females express phoretomorphy, and all are monomorphic.

Eight species of *Pyemotes* are natural enemies of one or more forest insects. Six attack bark beetles, four attack beetles infesting stored timber, and one attacks a needle sheath midge.

Reported earlier (Moser, et al., 1986), we describe here another species in the *ventricosus* subgroup parasitic on *Barbara colfaxiana* (Kearfott), one of the cone and seed insects. There are no records in the literature of cone and seed in-

sects being attacked by other species of the genus *Pyemotes*.

The setal and tergal signatures as used by Lindquist (1977) and Kaliszewski and Rack (1985) are used in part for the dorsal taxonomic descriptions. All measurements are given in microns and are based on sample sizes of four males and four females. The mean followed by the range in parenthesis is provided.

Pyemotes barbara, n. sp.
(Figs. 1-5)

DIAGNOSIS — This species is most closely related to *Pyemotes herfsi* (Oudemans 1936). It can be separated by the following characters. Seta Sc1 (Pseudostigmata) is elliptical on *herfsi* but globoid on *barbara*. Setae C₁ and C₂ are ca. equal in length on *herfsi*, whereas C₁ is longer than C₂ on *barbara*. Setae e bases are located above the bases of setae f on *herfsi*, but e bases are parallel or adjacent to the bases of f on *barbara*.

FEMALE — Body length 322 (293-346); width 129 (106-146). Gnathosoma (Fig. 1) ovoid-like, dorsally with 1 pair of simple setae; palpi anterolaterally with 2 pairs of simple setae; posterior pair 1/3 longer than anterior pair; venter of palpi with 2 pairs of simple setae, 1 small solenidion and 1 oblong sucking apparatus. Propodosomal shield subrectangular, longer than

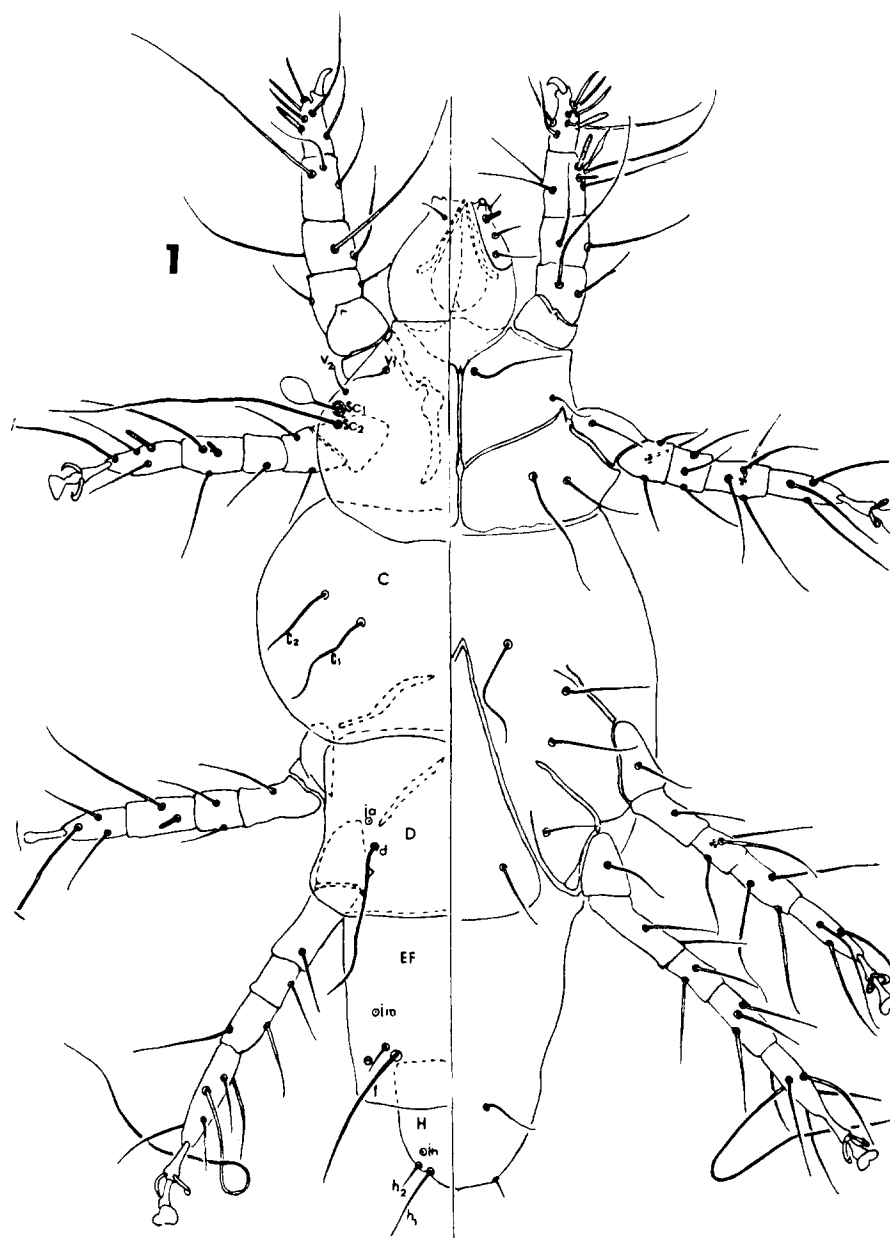


Fig. 1. *Pyemotes barbara*, n. sp., female, dorsal and ventral view.

wide; with setae V_1 , V_2 and Sc_2 smooth; Sc_2 extremely long, longer than length of leg I; Sc_1 globoid. Stigmata with light sclerotized cuticular area. Peritreme long and slender, extending to tracheal trunk. Dorsal hysterosoma with 4 tergites; tergite C largest as figured, with setae C_1 and C_2 ; setae C_1 ca. 1/10 longer than setae C_2 ; tergite D subrectangular, ca. as wide as long, with setae d being smooth and slender. Tergite EF with setae e and f setal bases parallel to each

other; e ca. 1/10 as long as f. Tergite H with setae h_1 and h_2 . Setae d and f ca. equal in length, both more than twice as long as setae h_1 . Setae e and h_2 ca. equal in length, less than half length of setae f and h_1 . Venter of propodosoma and hysterosoma as figured. Apodeme I short, converging with anteromedian apodeme; apodeme II thicker, more sclerotized than apodeme I. Anteromedian apodeme converging with transverse apodeme. Posteromedian apodeme not visi-

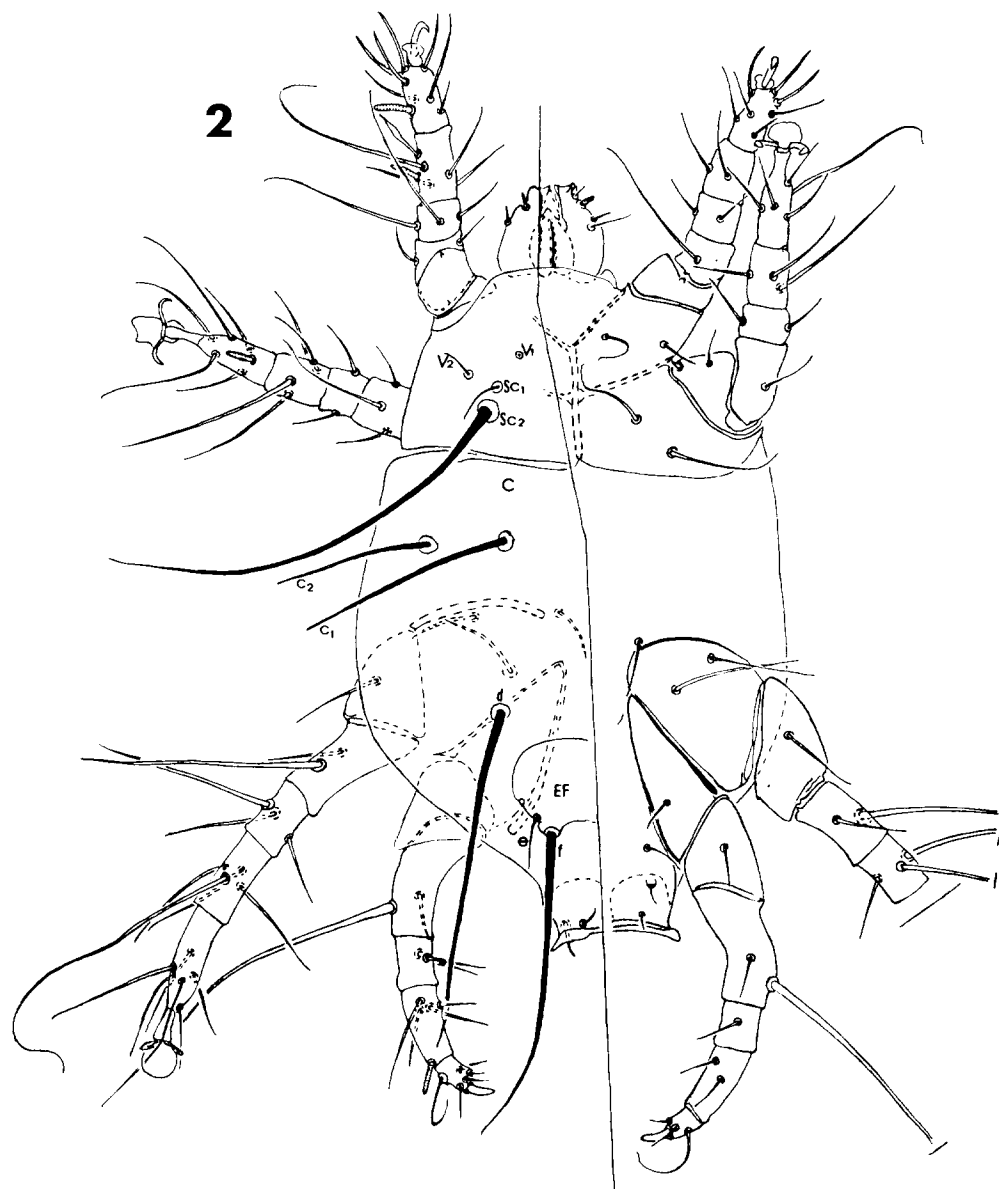


Fig. 2. *Pyemotes barbara*, n. sp., male, dorsal and ventral view.

ble; apodemes III and IV strongly sclerotized. Ventrocaudal lobe between legs IV spade shaped distally. Coxal setal formula: 2-2-2-1. Trochanters 1-1-1-1. Setation on femur, genu, tibia, and tarsus of leg I: 4-4-5+2 solenidia + 1 eupathidium -4+4 eupathidia + 1 solenidium; leg II, femur, genu, tibia, and tarsus: 3-3-4+1 solenidium -6+1 solenidium; leg III, femur, genu, tibia, and tarsus: 2-3-4+1 solenidium -7; leg IV, femur, genu, tibia, and tarsus: 2-2-4-6. All tarsal claws uncinated.

MALE — Body length 206 (199-213); width 122 (119-133). Gnathosoma (Figs. 2,5) ovoidlike. Palpi 1 segmented, dorsally with 1 pair of simple setae; venter of palpi with 3 pairs of simple setae, posterior pair ca. twice as long as anterior pair; anterolaterally with 1 small solenidium and 1 small sucking apparatus. Gnathosoma medially with 1 pair lateral simple setae. Propodosomal shield subrectangular, longer than wide; with setae V_1 , Sc_1 , and Sc_2 smooth. Setae Sc_2 as in female, extremely long, longer than length of leg I.

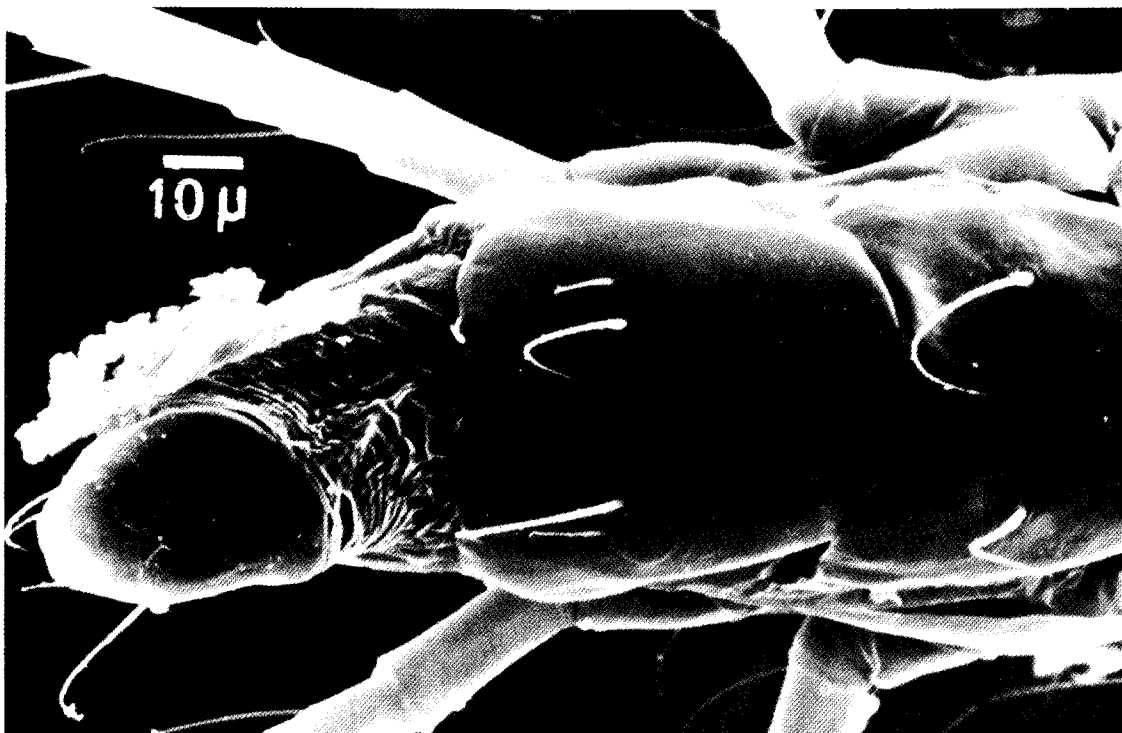


Fig. 3. *Pyemotes barbara*, n. sp., female, dorsal aspect of segments EF and H showing the intersegmental membrane caught in the incipient stage of expansion. This is the only part of the mite in which swelling (physogastry) occurs.

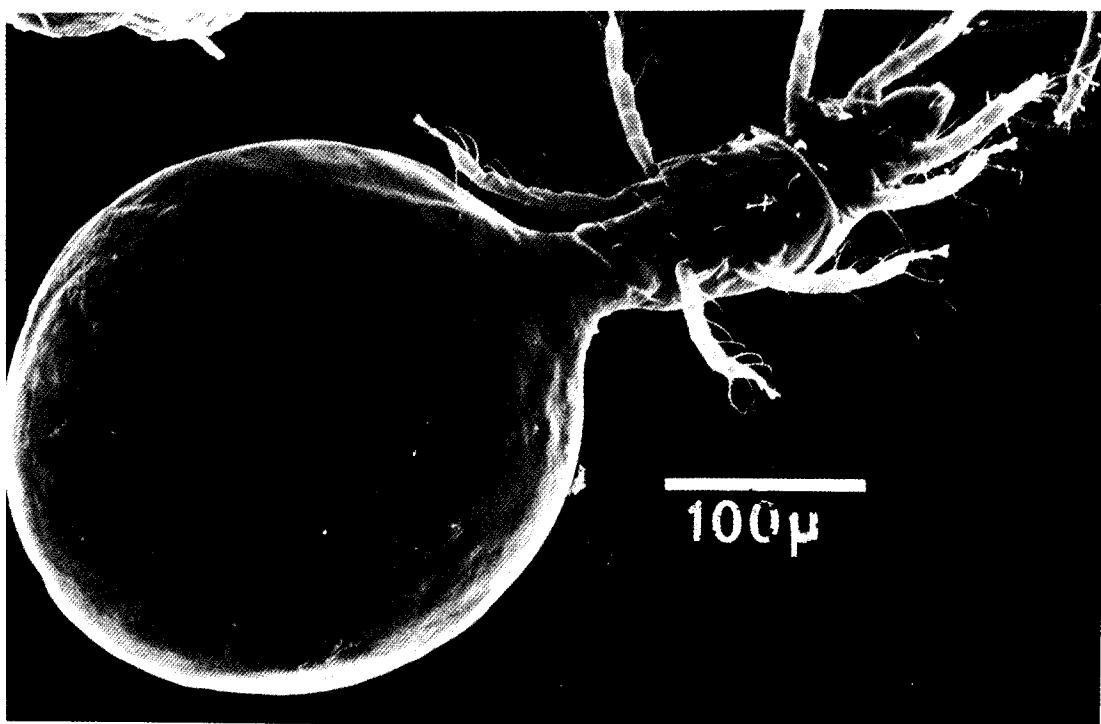


Fig. 4. *Pyemotes barbara*, n. sp., female, ventral aspect with the intersegmental membrane about 1/10 expanded after feeding about two days. The condition is plastic (not elastic) because the tissue never contracts.

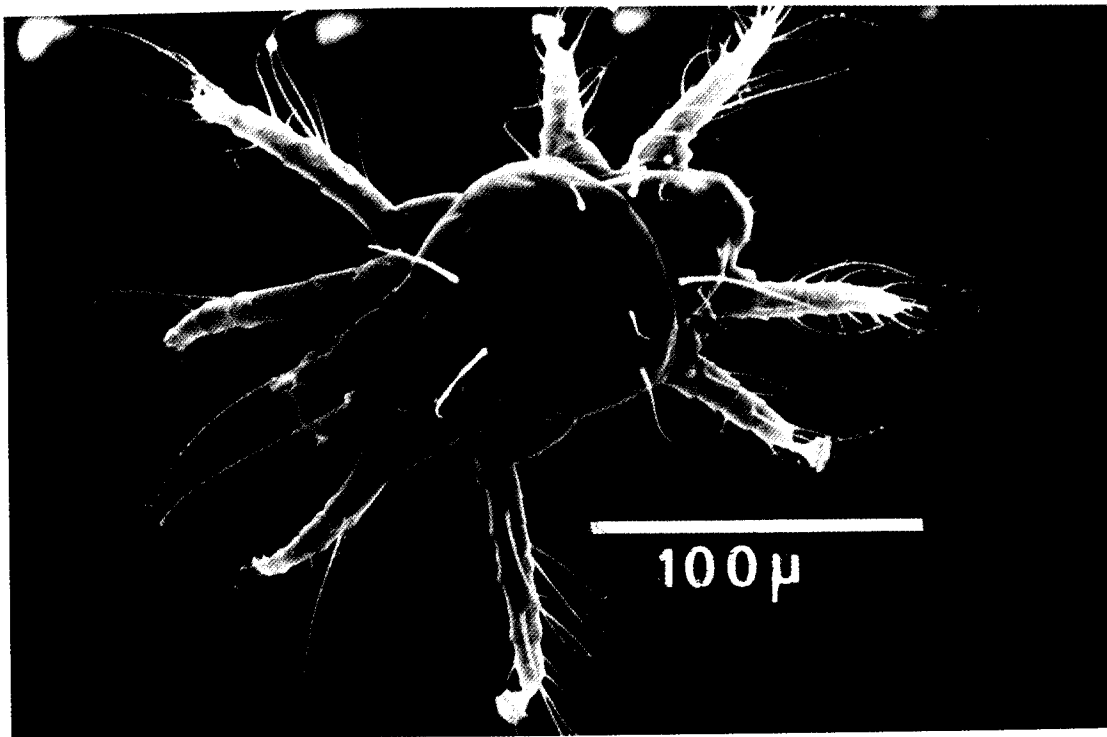


Fig. 5. *Pyemotes barbara*, n. sp., female, male dorsum.

Dorsal hysterosoma with tergites C and D fused together; bearing simple setae C₁, C₂, d, and cupule ia. Tergite EF subrectangular with simple setae e and f and cupule im; setae f ca. same length as setae d. Tergite H subrectangular, with setae h₂; h₁ absent. Venter of propodosoma and hysterosoma as figured. Apodemes I converging with anteromedian apodeme. Apodeme II ca. same length as apodeme I, converging with anteromedian apodeme; anteromedian apodeme converging with transverse apodeme. Posteromedian apodeme not visible. Apodemes III and IV as figured. Coxal setal formula: 2-2-3-1. Trochanters 1-1-1-1. Setation on femur, genu, tibia and tarsus of leg I: 4-4-5+1 solenidion + 1 eupathidium - 7+1 solenidion + 4 eupathidia; leg II, femur, genu, tibia, and tarsus: 3-3-4-6+1 solenidion; leg III, femur, genu, tibia, and tarsus: 2-3-4+1 solenidion -6; leg IV, femur, genu, tibia, and tarsus: 2-2-4+1 solenidion -5. All tarsal claws uncinated.

According to the key by Cross, et al. (1981), the male of *barbara* will key out to couplet 15, the end of the key for males of *Pyemotes*. The female of this species will key out at the end of couplet 20 "*ventricosus* group." There is no key to

separate the female species in this group. The key for the male species is emended as follows:

15. Hysterosomal setae e and f not subequal in length or size..... 15a
 — Hysterosomal setae e and f subequal in size...
n. sp. "A"
 15a. Hysterosomal setae e several times longer and thicker than f.....n. sp. "B"
 — Hysterosomal seta e not as above.....
*barbara*, n. sp.

TYPES — Holotype female, U.S. National Museum of Natural History, collected from pupa inside a cocoon of *Barbara colfaxiana* from Kere-meos, British Columbia, July 1966, by D. S. Ruth and A. F. Hedlin. Paratypes: Three females and 4 males with the above data.

ETYMOLOGY — The species is named in reference to the host *Barbara colfaxiana* from which it was collected.

DISCUSSION

Physogastric females (Figs. 3, 4) of *P. barbara* were first discovered by D. S. Ruth, who saw the mites parasitizing pupae of the Douglas-fir cone moth, *Barbara colfaxiana* (Kearfott) (Lepidoptera:

Tortricidae). Moth pupae were dissected from Douglas-fir cones collected at Keremeos, British Columbia, July 1966. The pupae were placed between filter papers in glass jars, covered with a screen lid, and divided into two lots. One lot was stored in a shade house at the Pacific Forestry Centre laboratory at Victoria, B.C., and the other lot was kept at another facility at Cowichan Lake, about 100 km NW of Victoria. When the pupae from both places were inspected at the Victoria laboratory on Feb. 2, 1967, the mites were found.

The mite was rediscovered September 17, 1986, at the type locality (a natural stand of Douglas-fir) at Keremeos. Cones were collected by pole pruner and brought back to the laboratory where the cones were dissected September 19. From 77 cones, 90 *B. colfaxiana* pupae were found. *Pyemotes barbara* females were found feeding on two pupae from different cones. As some of the *Pyemotes* females were in advanced stages of physogastry, and because the moth pupae were only off the trees for 2 days, there was no possibility that the pupae were attacked by *Pyemotes* after the cones were harvested. No other insects were found in the cones. In another area at Osoyoos (30 km SW of Keremeos), 72 cones yielded 100 pupae of *B. colfaxiana*, but no *Pyemotes* were seen.

At Keremeos, trees from which the cones were collected ranged from 15-20 m high, averaged .25 m dbh, and were 60-80 years old. At Osoyoos, trees ranged 15-18 m high, averaged .35 m dbh, and were 50-80 years old. Here the trees were part of a natural regeneration scattered around in a "farmland" setting. At both localities the Douglas-fir would be considered growing at the perimeter of its range. None of the people working in either of the two areas were aware of the trees being sprayed with insecticides, a factor contributing to the appearance of *Pyemotes emarginatus* Cross, Moser, and Rack in that seed orchard (Cross, et al., 1981).

Several females of *Pyemotes barbara* readily attacked *B. colfaxiana* pupae, *Dendroctonus ponderosae* Hopkins, and *Estigmene acrea* (Drury) larvae offered to them in the laboratory. The *P. barbara* female venom was potent, as the small and lightly sclerotized *D. ponderosae* larvae ceased movement 15 minutes after attack. The larger and more heavily sclerotized *B. colfaxiana* pupae

took about 8 hours to paralyze. The mites attached anywhere on the beetle larvae but always fed at intersegmental membranes on the moth pupae.

The effectiveness of *P. barbara* as a natural control agent is unknown, but examination of the preserved pupae of *B. colfaxiana* revealed large numbers of attached physogastric females, as well as unfed females and males. This suggests that this species may be capable of the explosive population buildups characteristic of many *Pyemotes* species. If *P. barbara* is typical of most members of the *ventricosus* subgroup, it will readily attack other cone and seed insects as well. Also, if typical, it may be easy to rear and distribute as a biological control tool to prevent cone and seed insects from exceeding economic injury thresholds.

The straw itch mite, *Pyemotes tritici* Lagreze-Fossat and Montane is currently in use as a commercial biological control agent. Bruce (1983) rates *P. tritici* as an effective parasite due to the following characteristics: (1) high reproductive potential; (2) short life cycle (4-7 days); (3) no intermediate hosts or food sources required—all development occurs within the opisthosomal sac of the adult female and all offspring are born live as sexually mature adults; (4) females represent about 95% of the population; (5) females mate immediately at birth and begin host-seeking; (6) populations are easily reared and synchronized in the laboratory; and (7) cosmopolitan distribution.

Because large numbers of *P. barbara* were seen on the *B. colfaxiana* pupae, there is reason to believe that this species has the *P. tritici* characteristics, except perhaps (7). Similar to *P. emarginatus* Cross, Moser, and Rack, the species being another member of the *ventricosus* subgroup inhabiting conifers, *P. barbara* also has a potent venom. This has been a potential drawback to the commercial use of *P. tritici* because of human toxicity. *P. barbara* may also have the advantage of being better adapted climatically and ecologically than commercial varieties of *P. tritici*.

ACKNOWLEDGMENTS

We wish to thank J. R. Gorham, Food and Drug Administration, Washington, DC, and W. A. Bruce, USDA-ARS Stored Products Research and

Development Laboratory, Savannah, GA for reviewing this manuscript. We also wish to thank Mrs. Lesley E. Manning for taking the SEM micrographs and making the prints.

REFERENCES

- Bruce, W. A. 1983. Mites as biological control agents of stored product pests, pp. 74-78. In M. A. Hoy, G. L. Cunningham, and L. Knutson, eds., Proceedings of the work conference, "Biological control of pests by mites," University of California Press, Berkeley, vi+185 pp.
- Cross, E. A., J. C. Moser and G. Rack. 1981. Some new forms of *Pyemotes* (Acarina: Pyemotidae) from forest insects, with remarks on polymorphism. Internat. J. Acarol. 7(1): 179-196.
- Kaliszewski, M. and G. Rack. 1985. Description of female and male of *Pygmephorus sylvilagus* n. sp. and male of *Pygmephorus erlangensis* Krczal 1959 (Acari: Pyemotidae). Entomol. Mitt. Zool. Mus. Hamburg. 8(123): 45-60.
- Moser, J. C., R. L. Smiley, I. S. Otvos, and P. L. Lorio, Jr. 1986. *Pyemotes* n. sp. (Acari: Pyemotidae), a potential biological control agent for cone-and-seed insects. In Proceedings of the 2nd IUFRO conference of the cone and seed insects working party S2.07-01. A. Roques, ed., Briancon, France, September 3-5, 1986.
- Lindquist, E. E. 1977. Homology of dorsal opisthosomal plates, setae, and cupules of heterostigmatic mites with those of other eleutherengone Prostigmata. Acarologia 19(1): 97-104.
- Oudemans, A. C. 1936. Neues über *Pediculoides* Targ. Tozz. 1878. Festschrift f. Embrik Strand. 1: 391-404.